4-11. Generally, $\boldsymbol{k}\cdot\boldsymbol{r}=k_x\,x+k_y\,y+k_z\,z$.

(a) For propagation along the z-axis, $k_x=k_y=0$, So $\boldsymbol{k}\cdot\boldsymbol{r}=k_z\,z$, with $k_z=2\,\pi/\lambda$. The waveform can then be written as,

$$\psi=A\sin(\boldsymbol{k}\cdot\boldsymbol{r}-\omega\,t)=A\sin(k_z\,z-\omega\,t)=A\sin\left[\frac{2\,\pi}{\lambda}(z-v\,t)\right]=A\sin 2\,\pi(z/\lambda-v\,t)$$

(b) In this case, $k_z=0$ and $k_x=k_y=|k|/\sqrt{2}=\dfrac{1}{\sqrt{2}}\dfrac{2\,\pi}{\lambda}$. The general form of the wave is then,

$$\psi=A\sin(\boldsymbol{k}\cdot\boldsymbol{r}\pm\omega\,t)=A\sin(k_x\,x+k_y\,y\pm\omega\,t)=A\sin\left[\frac{2\,\pi}{\sqrt{2}\lambda}(x+y\pm v\,t)\right]=A\sin 2\,\pi\left(\frac{x}{\sqrt{2}\lambda}+\frac{y}{\sqrt{2}\,\lambda}\pm v\,t\right).$$

If one is interested in the wave displacement only on the line $x=y$,

$$\psi=A\sin 2\,\pi\left(\frac{2x}{\sqrt{2}\lambda}\pm v\,t\right).$$

(c) In this case $\boldsymbol{k}=\dfrac{k}{\sqrt{3}}(\hat{\boldsymbol{x}}+\hat{\boldsymbol{y}}+\hat{\boldsymbol{z}})$ and $\boldsymbol{k}\cdot\boldsymbol{r}=\dfrac{k}{\sqrt{3}}(x+y+z)$, with $k=2\,\pi/\lambda$. The waveform is then,

$$\psi=A\sin(\boldsymbol{k}\cdot\boldsymbol{r}\pm\omega\,t)=A\sin\left[\frac{k}{\sqrt{3}}(x+y+z)\pm\omega\,t\right]=A\sin\left[\frac{2\,\pi}{\sqrt{3}\lambda}(x+y+z\pm v\,t)\right]$$

4-12. Let $\tilde{z}=a+i\,b$ where a and b are real.

(a) $(\tilde{z}+\tilde{z}^*)/2=(a+i\,b+a-i\,b)/2=a=\mathrm{Re}(\tilde{z})$

(b) $(\tilde{z}-\tilde{z}^*)/2i=(a+i\,b-a+i\,b)/2i=b=\mathrm{Im}(\tilde{z})$

(c) Let $\tilde{z}=e^{i\theta}=\cos\theta+i\sin\theta$ and apply the result from (a): $\cos\theta=\left(e^{i\theta}+e^{-i\theta}\right)/2$

(d) Let $\tilde{z}=e^{i\theta}=\cos\theta+i\sin\theta$ and apply the result from (b): $\sin\theta=\left(e^{i\theta}-e^{-i\theta}\right)/2i$

4-13. (a) Note that $e^{i\pi/2}=\cos(\pi/2)+i\sin(\pi/2)=i$ so that

$$i\,A\,e^{i(\boldsymbol{k}\cdot\boldsymbol{r}-\omega t+\varphi_0)}=e^{i\pi/2}\,A\,e^{i(\boldsymbol{k}\cdot\boldsymbol{r}-\omega t+\varphi_0)}=A\,e^{i(\boldsymbol{k}\cdot\boldsymbol{r}-\omega t+\varphi_0+\pi/2)}$$

(b) Similarly, $e^{i\pi}=\cos(\pi)+i\sin(\pi)=-1$ so that

$$-A\,e^{i(\boldsymbol{k}\cdot\boldsymbol{r}-\omega t+\varphi_0)}=e^{i\pi}\,A\,e^{i(\boldsymbol{k}\cdot\boldsymbol{r}-\omega t+\varphi_0)}=A\,e^{i(\boldsymbol{k}\cdot\boldsymbol{r}-\omega t+\varphi_0+\pi)}$$

5-4. One could proceed directly by mimicking the development for the cosine waves leading to Eqs. (5-9) and (5-10). I choose to first convert the given fields to the cosine form and then using those equations. That is,

$$y_1=5\sin(\omega\,t+\pi/2)=5\cos(\omega\,t)=5\cos(0-\omega\,t)$$
$$y_2=7\sin(\omega\,t+\pi/3)=7\cos(\omega\,t+\pi/3-\pi/2)=7\cos(\omega\,t-\pi/6)=7\cos(\pi/6-\omega\,t)$$

Them using Eqs. (5-9) and (5-10):

$$y_0=\sqrt{5^2+7^2+2\cdot 5\cdot 7\cos(\pi/6)}=11.6$$
$$\tan\alpha=\frac{0+7\sin(\pi/6)}{5+7\cos(\pi/6)}=\alpha=0.098\,\pi$$
$$y=11.6\cos(0.098\,\pi-\omega\,t)=11.6\cos(\omega\,t-0.098\,\pi)=11.6\sin(\omega\,t-0.098\,\pi+\pi/2)$$
$$y=11.6\sin(\omega\,t+0.402\,\pi)$$